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Fingerprint Based Biometric Voting Machine with Arduino Uno

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ABSTRACT: This project provided a fingerprint-based voting machine design solution based on an Arduino Uno. Electronic voting machines employ fingerprint sensors as a biometric method of voter verification. The voter would not need to carry his ID, which has all of the required information, in order to utilize the finger print-based voting apparatus under this suggested design. Voters can instantly produce a fingerprint for use as identification by just placing their finger on the scanner at the polling place. This fingerprint reader reads the data on the tag. This data is sent to the controlling unit for validation. After retrieving the data from the reader, the controller compares it to the information that was previously entered during voter registration. If the information matches the previously stored information on the registered fingerprint, the voter is allowed to cast a ballot. In the event that it is not, a warning notice appears on the LCD and the voter is blocked from casting a ballot. The voting process is manually operated by pushing buttons. To display the pertinent warnings, cautions, and results, LCD is utilized.

I. INTRODUCTION

The strands of human expression and imagination are woven together to create the great tapestry that is literature. It includes a broad variety of written works, such as plays, essays, novels, and poems, each of which provides a distinctive window into the human condition. Works of literature have the power to take us to new places, evoke strong feelings, and provoke thought. Literature is more than just stories; it frequently captures the historical, social, and cultural circumstances in which it is produced. Our collective imagination is dynamically and constantly changingly reflected in literature.



Figure 1 illustrates the block diagram of the Internet of Things.

The Fingerprint Based Voting Project is a technique that identifies an individual based on their finger patterns. Everybody has a different pattern on their fingers, which makes it simple to identify the voter. When utilizing this method, voters can authenticate themselves with their fingerprints. Fingerprints are able to identify the user. Every fingerprint is unique, consisting of several little pieces. The voters' identities are verified by their fingerprints. A voter may select a candidate just once, and the system will prevent them from doing so in the future. Upon gaining access to the system, the administrator will be able to input the names and images of the candidates who have been put forward for nomination. Entering the names and additional data is the administrator's sole duty. The amount of candidates the administrator added to the system will be eliminated right away after the election. The election's finish date must be

stated by the administration. After receiving their user ID and password from the administrator, the user can log in and cast their vote for the candidates who have been nominated. Through the system, the user will only be able to choose one candidate. Thanks to technology, the user will only be able to vote once per election. When a new election is called, the administration is free to add as many candidates as they choose. The administrator can view the election results by entering the election ID. Users can also view the outcomes of the election.

II. HOW IT WORKS

The operation of the biometric voting method can be a little unclear to novices. First, the user needs to enlist fingers or votes using push buttons or keys (this code allows for a maximum of 25 voters). When the ENROLL key is pressed, the LCD will ask the user to provide their ID and location, using their finger as a storage device. Therefore, in order to enter ID (Location), the user must now use the UP/DOWN buttons. Once Location/ID has been selected, the user needs to press the OK key (DEL key). At this point, the LCD will ask the user to place their finger over the finger print module. At the moment, the user needs to cover the fingerprint module with his finger. After that, the LCD will ask you to remove your finger from the finger print module and urge you to put it back in.

This requires the user to touch the finger print module with his finger once more. Now, the finger print module creates templates from an image, which it stores in memory in accordance with a selected ID. After registering, the voter is now qualified to cast a ballot. The same process can be used to register every voter in the system. To erase or delete any saved ID, the user must now hit the DEL key. Next, by selecting the place, the LCD will prompt the user to select which ID to erase. The user must now choose ID and hit the OK key (the DEL key). The LCD will now notify you that the finger has been successfully erased.

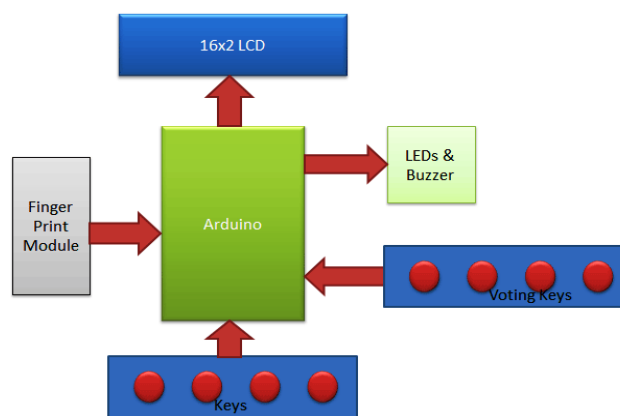


Figure 2: block diagram

III. VOTING PROCESS

In order to cast a vote, the user must now hit the match key. A buzzer will then sound, the LED will light up, and the LCD will prompt the user to place their finger on the fingerprint module. Arduino will now provide you three chances to place your finger. Once a finger is placed over the fingerprint module, the fingerprint module takes a picture of the finger and determines whether its ID is in the system. Authorized Voter will be displayed on the LCD if finger ID is detected. It indicates that the user has voting rights. The system then advances to the voting stage.

Now that the green LED is glowing, voters may cast their ballots by hitting the designated key, which in this case is the red bread board. The system will now indicate "Already Voted" if the same voter wishes to cast another ballot. The buzzer will beep for five seconds and the voter will not be able to vote again. The finger print module will not recognize the non-registered user's ID in the system and the LCD will display "No Fingerprint Found" if the non-registered user attempts to vote.

Here, CAN1, CAN2, and CAN3 stand in for the candidates who have filed for election: Candidates 1, 2, and 3.

IV. SYSTEM OVERVIEW

With an Arduino for project administration, a push button for registering, deleting, selecting IDs, and voting, a buzzer for alerts, LEDs for indication, and a 16x2 LCD for voter instruction and result display, this fingerprint-based voting machine project features a very simple circuit. When the yellow LED illuminates, the fingerprint module is prepared to capture a finger image; when the green LED illuminates, the system is prepared to gather votes or present the results.

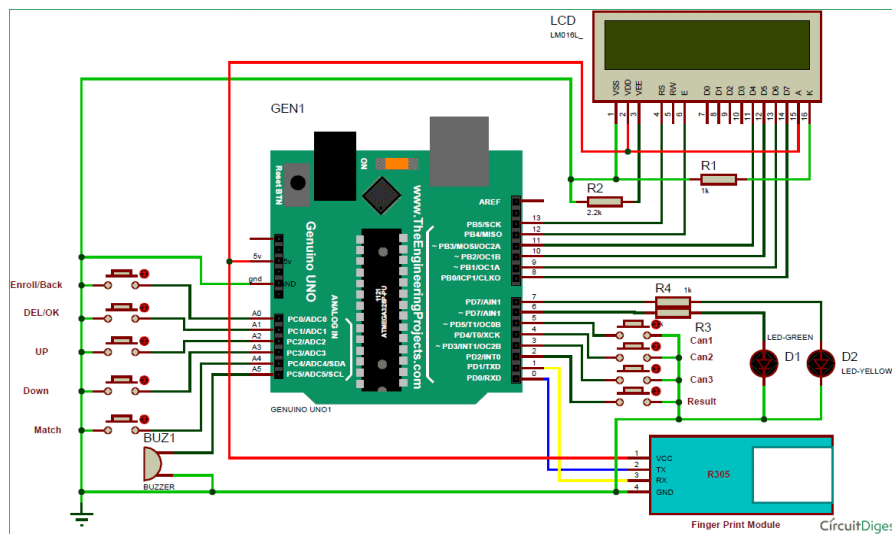


Figure 3: System circuit Diagram

The Arduino pins A0 (ENROL), A1 (DEL), A2 (UP), A3 (DOWN), and A4 (Match), D5 (Can1), D4 (Can2), D3 (Can3), and D2 (Result) are directly linked to the push button in relation to ground. A 1k resistor is used to link the Arduino's digital pin D7 (yellow LED) to earth, and the same resistor is used to connect the Arduino's digital pin D6 (green LED). The Arduino's serial pins Tx and Rx are directly linked to the Rx and Tx of the fingerprint module. A 5 volt supply powers the finger print module on the Arduino board. A buzzer is additionally linked at A5. Arduino's digital pins D13, D12, D11, D10, D9, and D8 are directly connected to the RS, EN, D4, D5, D6, and D7 of a 16x2 LCD in 4-bit mode.

V. HARDWARE DESCRIPTION

- **ARDUINO UNO**

The UNO is one of Arduino's standard boards. In this context, UNO is the Italian term for "one." The original Arduino software release was referred to as UNO in order to distinguish it. It was also the first USB board released by Arduino. It is thought of as a robust board that may be used for a variety of purposes. Arduino.cc is the company that made the Arduino UNO board. The ATmega328P microprocessor serves as the foundation for the Arduino UNO. It is easy to use as opposed to other boards, like the Arduino Mega board, etc. The board consists of digital and analog input/output (I/O) pins, extra circuitry, and shields.

The Arduino UNO has fourteen digital pins, six analog pin inputs, a USB port, a power jack, and an ICSP (In-Circuit Serial Programming) header. Programming is done using the Integrated Development Environment, or IDE. Both online and offline contexts can use it.

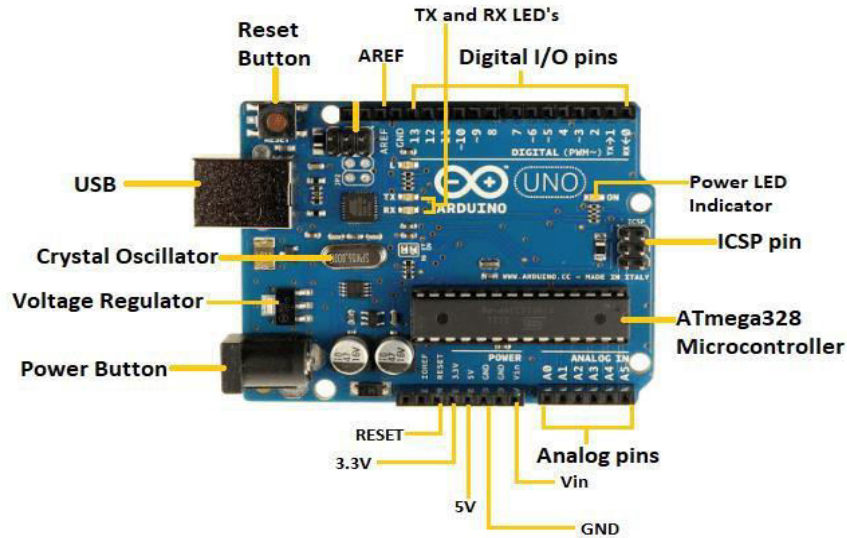


Fig.5.1 ARDUINO BOARD

BOARD ARCHITECTURE

Every single Arduino board needs a way to connect to a power source. The Arduino UNO can be powered via a USB cable that ends in a barrel connector on your computer or by a wall power supply (like this one). In the above illustration, the USB connection is identified (1), and the barrel jack is shown (2). Using the USB connection, you may also load code into your Arduino board. For additional information on how to program with Arduino, see our Installing and Programming Arduino article. Pins: AREF, Digital, PWM, 3.3V, 5V, GND, and Analog.

You can create a circuit by attaching wires to the Arduino pins (typically with the help of a breadboard and some wire). They usually come with "headers" (black plastic pieces) that allow you to easily plug a wire into the board. The Arduino contains several different kinds of pins, each with a unique purpose and identification on the board.

- GND (3): An acronym for "ground." The Arduino has many GND pins that you may utilize to ground your circuit.
- 3.3V (5) & 5V (4): The 5V pin provides 5 volts of electricity, as one might expect, while the 3.3V pin provides 3.3 volts. The majority of the basic parts that are used with the Arduino gladly operate on 3.3 or 5 volts.
- Analog (6): Analog In pins are those found in the region designated by the label "Analog In" on the UNO (A0 through A5). These pins have the ability to read an analog sensor's signal, such as a temperature sensor, and translate it into a readable digital value.
- Digital (7): On the UNO, the digital pins (0–13) are situated across from the analog pins. These pins allow for both digital input and output—for example, turning on an LED or detecting whether a button is pressed.
- PWM (8): It's possible that the tilde (~) was placed adjacent to several of the digital pins on the UNO, specifically 3, 5, 6, 9, 10, and 11. These pins have the ability to perform as standard digital pins as well as be used for pulse-width modulation, or PWM. Consider these pins to be capable of simulating analog output for the time being (e.g., fading an LED in and out). We are learning about PWM.
- AREF (9): Analog Reference is the acronym. For the most part, you may ignore this pin. Occasionally, it is employed to establish an external reference voltage (ranging from 0 to 5 volts) as the maximum value for the analog input pins.

Reset Button

The Arduino's reset button (10) is the same as the one on the original Nintendo. You can use it to temporarily link the reset pin to ground and resume any code that is currently running on the Arduino. This can be quite useful if you want to test your code more than once but it doesn't repeat. But unlike the original Nintendo, most issues are seldom resolved by blowing on the Arduino.

Power LED Indicator

A little LED appears next to the word "ON" on your circuit board, immediately below and to the right of the word "UNO" (11). This LED should illuminate each time you plug your Arduino into a power source. In the event that this light is off, there's probably a problem. It's time to give your circuit another look.

TX RX LEDs

Transmit is shortened to TX, and receive is shortened to RX. In electronics, these marks are frequently used to identify the pins used for serial transmission. In our example, TX and RX are shown twice on the Arduino UNO: once near digital pins 0 and 1, and again close to the TX and RX indication LEDs (12). When our Arduino is receiving or transferring data (such as when we're putting a new software onto the board), these LEDs will provide us with some great visual cues.

Main IC

Integrated circuits, or ICs, are the black objects with all the metal legs (13). Consider it to be our Arduino's brains. The primary integrated circuit (IC) of an Arduino board varies significantly depending on the kind of board, although it typically comes from ATMEL's AT mega range of ICs. This might be crucial since, before running a new program from the Arduino software, you might need to know the IC type in addition to your board type. Usually, this information is written in writing on the IC's top side. Reading the datasheets is frequently a smart option if you want to learn more about the differences between different integrated circuits.

Voltage Regulator

Actually, you shouldn't (or can't) interact with the voltage regulator (14) on the Arduino. But knowing that it exists and for what purpose might be helpful. As stated, the voltage regulator regulates the voltage that is allowed to reach the Arduino board. Consider it to be a sort of gatekeeper, blocking any excess voltage that may damage the circuit. It has its limitations, of course, so don't connect your Arduino to any voltage higher than 20 volts.

Fingerprint Sensor Module

The finger print sensor module makes fingerprint registration, comparison, search, and collection incredibly simple. These modules are compatible with any microcontroller or TTL serial system and have FLASH memory for storing fingerprints. These modules can be added to a variety of systems, including time attendance, door locks, and security systems.



Fig.5.2 Fingerprint module

Details

These are the fingerprint sensor module's parameters. DC 3.6 to 6.0V voltage supply;
<120mA current supply

Backlight color: green

- Interface: UART
- Bad rate: 9600

- Safety level: five (from low to high: 1,2,3,4,5)
- False Accept Rate (FAR): <0.001% (security level 3)
- False Reject Rate (FRR): <1.0% (security level 3)
- Able to store 127 different fingerprints

Sensor Pinout

The sensor has six pins that are labeled in the figure below.

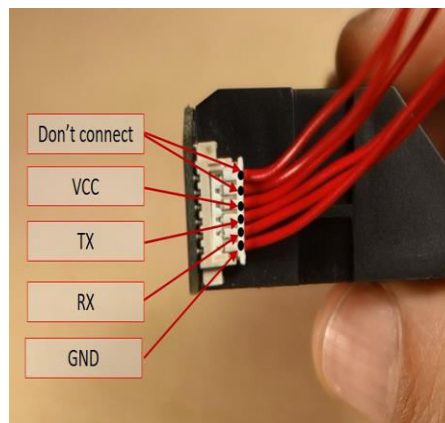


Fig.5.3 fingerprint pinout

The following table shows how to wire the sensor to the Arduino.

Lcd display

The acronym for liquid crystal display is LCD. There are several circuits and devices that use this specific kind of electronic display module, such as TVs, computers, calculators, cell phones, and more. These displays are mostly used in seven-segment and multi-segment light-emitting diodes. The main benefits of using this module are its inexpensive cost, simple programming, animations, and endless display options for a variety of effects, animations, and distinctive characters.

The 16x2 LCD pinout is shown below.

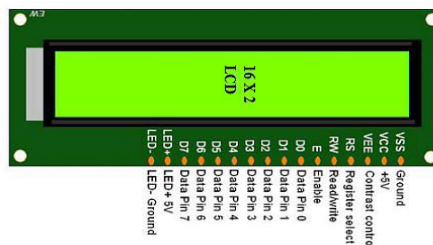


Figure 5.4: LCD display pin diagram

The features of this LCD mainly include the following.

- 4.7V–5.3V is the operational voltage of this LCD.
- It has two rows, each of which can display 16 characters.
- One mA of current is used without a backlight.
- Five by eight pixel boxes can be used to construct any character.
- Alphabetic and numeric LCDs.
- There are two modes for this display: 4-bit and 8-bit.

- Blue and green backlight options are available.
- A few custom produced characters are displayed.

Registers of LCD

A 16x2 LCD has two registers: the command register and the data register. Switching between registers is the main function of the register select (RS). When the register set is '0', it is called the command register. Similar to this, a register set with a value of '1' is called a data register.

Command Register

The command instructions that are sent to the display are stored in the command register, which serves this purpose. In order to carry out predetermined actions including initializing, clearing the screen, positioning the pointer, and controlling the display. In this case, instructions may be processed inside the register.

Data Register

Keeping the data that will be displayed on the LCD panel is the main responsibility of the data register. In this instance, the ASCII value of the character will be the data that is shown on the LCD panel. The process starts when the data register receives the information supplied to the LCD. When register set = 1, the data register will be selected.

VI. SYSTEM FLOW

1. Link the Arduino Uno to the fingerprint sensor
2. Attach the Arduino Uno to the push buttons.
3. Attach the Arduino Uno to the LCD display.
4. Using a USB cord, import the source code onto the Arduino Uno.

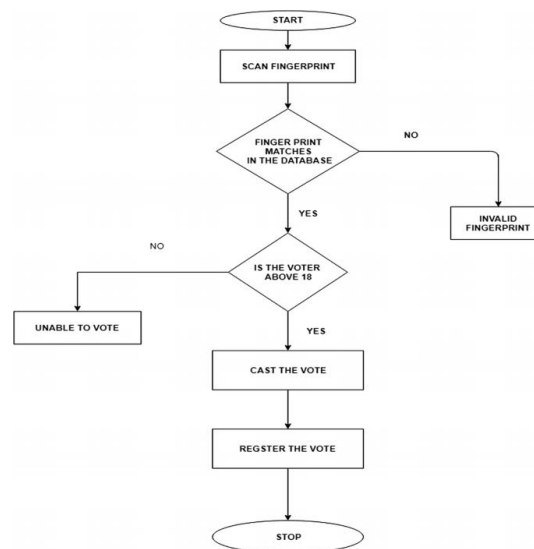


Figure 5.6: Flow Diagram

VII. RESULT AND DISCUSSION

A comprehensive strategy is required to analyze the outcomes of a voting system that uses biometric fingerprint technology. First, the total number of votes cast for each candidate or option should be tallied, and the percentage of votes received should be ascertained. This comparison facilitates the identification of the winner, who is the candidate with the highest number or percentage of votes. Voter turnout provides information on how effectively the voting system promotes participation when compared to the total number of votes cast to the eligible voter population. Demographic research, when it is available, examines voting patterns across a range of demographic categories, such as age, gender, and region. Validity checks verify that the total number of votes cast matches the number of ballots cast, and they look into any anomalies to assure the integrity of the election results. Protocols for dealing with ties or

contests without a clear winner must be put in place. Since the biometric fingerprint authentication method verifies that every vote is cast by an eligible and legitimate voter, its efficacy in preventing fraudulent voting is crucial. Along with the verification of legal compliance, input from stakeholders—voters and election officials, for example—helps identify areas that require improvement. This helps ensure that the election results are thoroughly documented and reported. Suggestions for future elections include adding more security, modifying the voting procedure, or implementing technology advancements to further improve the democratic process's legitimacy and openness.

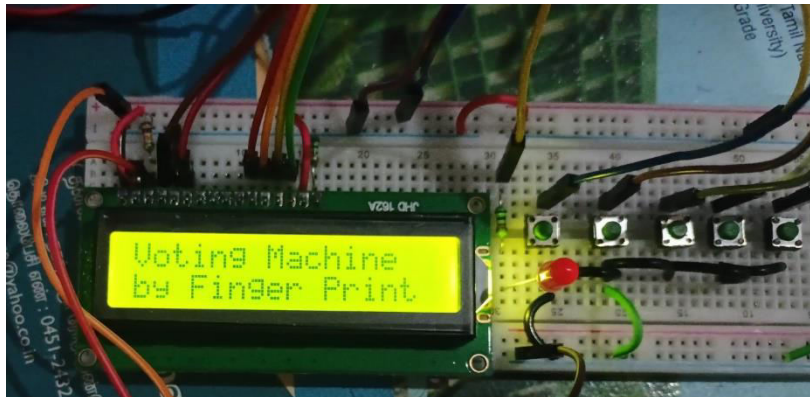


Figure 6: Voting Machine is On

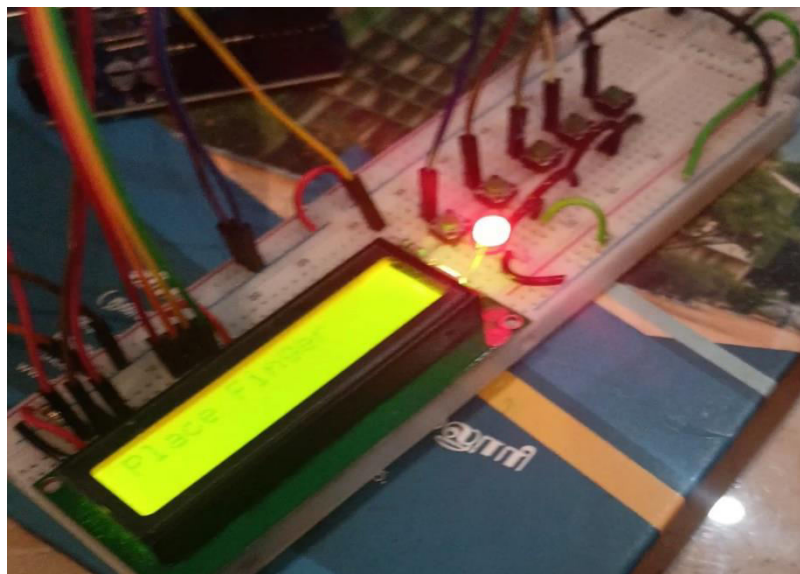


Figure 7: indicate the fingerprint module is active for verification

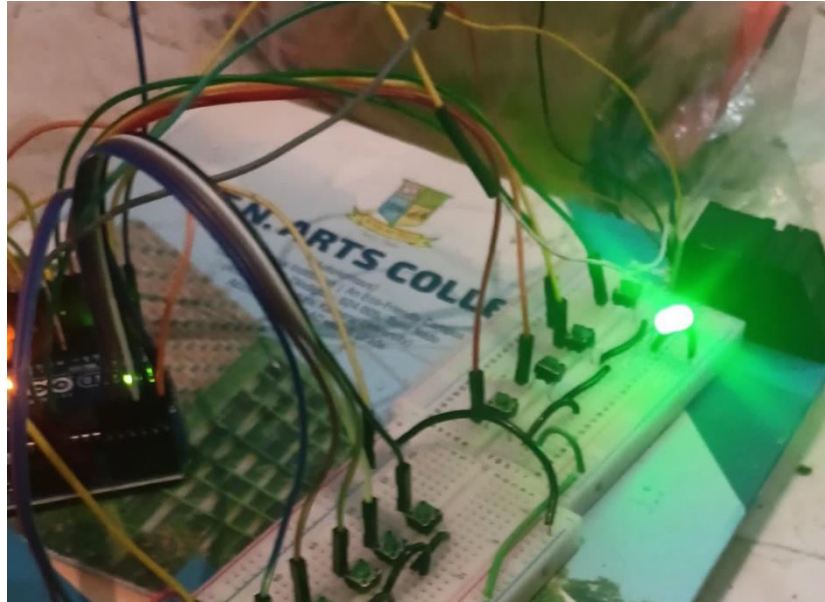


Figure 8: indicate the alert to vote

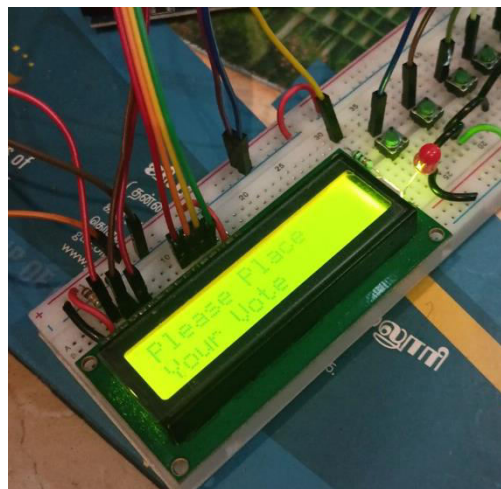


Figure 9: vote is placed



Figure 10: indicated and displayed to voter is already voted

VIII. CONCLUSION

Fingerprints have been one of the most popular ways to identify people for more than a century; automated biometric technologies have only recently been accessible. The job was executed and assessed effectively. The final results were more comparable and meaningful. It demonstrates that the fingerprint image enhancement phase will undoubtedly boost the fingerprint-based identification system's verification performance. Fingerprints will continue to be used with many government legacy systems and in new systems for emerging applications that require a trustworthy biometric since they are universally accepted by the public, law enforcement, and the forensic scientific community. In India, fair elections might be held with the help of this biometric voting method. This will make illicit activities like rigging impossible. With this exercise of their democratic right, the people may be certain that they alone will be able to select their leaders. The finger print module's memory can be increased. To increase the capacity, we may utilize a fingerprint module with 1 MB of flash memory. The fingerprint picture can be saved in external memory and retrieved at a later time for comparison. In order to increase security and decrease database storage, a smart card reader module is intended to be added to the current module.. Voting can be made easier for illiterate voters by including audio output. Retinal scanning can also be developed.

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